Ulysses Education and Outreach

Andrea Angrum
Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, M/C 264-801, Pasadena, CA 91109

Abstract:

Ulysses is a joint NASA/ESA mission that is exploring a three-dimensional structure of the heliosphere via an orbit over the poles of the Sun. Since its inception, Ulysses, both in NASA and ESA, has had a public and science outreach program; it is only within the last three years that the project has begun to expand its outreach activities to include education. Because Ulysses has no images, it has been a challenge to share scientific results with all levels of K-12, but Project personnel have been very resourceful and have participated in a variety of activities, including classroom presentations; developing and accompanying displays for museums, educational conferences and county and state fairs; establishing and maintaining over 16 sites on the worldwide web; and providing data to the science community. This paper will outline the various Ulysses outreach activities and provide information on how to access Ulysses science data, operational status and educational activities.

Introduction:

From the inception of the mission, getting the public excited about Ulysses has been part of the mission plan. We realize that, being a very unique mission - the only spacecraft exploring high latitudes of the Sun, we have information to share with the world. We also know that as a result of Ulysses findings, textbooks would probably have to be rewritten. Since the mission did not have images to share and because heliospheric physics is not an easy story to tell, we know we had to try extra hard to get the message to "John Doe", the average tax payer who wonders why there is a Ulysses mission. The same would be true of elementary and high school students. As a consequence, early outreach efforts concentrated in the scientific community and college level students. There were attempts to include lower educational levels, but they were sporadic. It has only been within the last few years that the project has concentrated on K-12 educational outreach. This has been somewhat complicated by the fact that there has been no Outreach budget. Still, the project personnel have been very resourceful in creating an outreach program to reach our intended audience. Current outreach activities and plans for the future are discussed in this paper.

Presentations:

Considering the minimal budget for Ulysses outreach, the project staff has been very resourceful. The Ulysses team has participated in numerous classroom presentations across the country. In these 20-60 minute presentations, the students are given a complete overview of the project using slides, viewgraphs and movies. Time is allocated for question and answer at the end. Since the spacecraft has no imaging instruments, we must be very creative in capturing the audience when working with students in grades K-12. We utilize photographs from other Sun-Earth Connection (SEC) programs and visual presentations of the Ulysses data. The scale model of the Ulysses spacecraft and of the space shuttle model with the S/C in the cargo bay are great tools for these type of classroom presentations. The visualization of spacecraft size and the location of spacecraft instruments help capture the audience's attention.

Another tool sometimes used for the younger students is the Ulysses spacecraft puzzle. The puzzle is 29" X 20" and has 12 large pieces approximately 4" - 5" in size. For the smaller children with short attention spans this tool channels their energy and allows the presenter a few moments to discuss some information about the Sun and the spacecraft. It also fuels their curiosity and generates questions that the presenter answers. The children feel more comfortable with the presenter because they are working with a tool that they are familiar with and feel more confident about asking questions. The children are always rewarded for participating in the activity with some sort of Ulysses memorabilia, i.e., buttons, pins, decals, postcards, bookmarks or posters. All products are Ulysses or Sun related and provide basic information, science results or statistics.

The Ulysses Principal Investigators, their team members and the Project Scientists give lectures at the University level. These lectures give a scientific overview of Ulysses accomplishments, describing such phenomena as the solar wind, cosmic rays, magnetic fields, gamma-ray bursts and energetic particles. Presentations have been given during "Space Day" at the California State University, Berkeley, California State University, Los Angeles' Department of Astronomy and Physics and The University of Florida, Gainesville, to name a few.

Exhibits:

Yearly, the Project commits to participating in various state and county fairs. The project office provides displays for the appropriate chosen theme, while the Project members volunteer their personal time to staff the exhibit. Ulysses has displayed exhibits at the Los Angeles County and the Del Mar State Fairs in California. Last year for the first Open House at the Deep Space Network's Goldstone facility, the Ulysses mission, Solar and Heliospheric Observatory (SOHO) and Outer Planets/Solar Probe missions collaborated on a display titled "Why Explore the SUN?" Approximately 3,000 people toured the facility and viewed the exhibits.

Annually the Jet Propulsion Laboratory opens its door to the public. At this event the Ulysses project is exposed to about 30,000 people in two days. During the JPL open house the Ulysses volunteers answer and ask questions of the public, the Ulysses puzzle is available for the younger crowd, and we play a word game with prizes to encourage and promote attention to the projects goals and recent science results.

In collaboration with the Los Angeles County Museum of Science and Industry, recently renamed the Los Angeles Science Center, the Ulysses team scheduled and supported a one-month exhibit. During this month, the museum curator, with the assistance of the museum's education staff and with the Los Angeles Unified School District arranged class tours to visit the Air and Space Museum. The Ulysses staff hosted 13,000 students during that month.

For the last two years, Ulysses has participated in the National Science Teacher Association conference, most recently in Las Vegas, NV on April 16-19, 1998. Two members of the Ulysses staff represented the project at the NASA exhibit/Sun-Earth Connection Display with other SEC forum member's i.e., SOHO, WIND, ACE, ISTP and POETRY. On Saturday, members of the Ulysses Operations Team presented a technology workshop for 12 educators at the NASA exhibit. They gave a brief project overview and displayed the JPL Ulysses web site and a few of the many Ulysses links at other locations. During this workshop, teachers viewed a three-D solar system game, the nutation game (techniques on commanding the spacecraft to correct nutation), classroom activities from the Unified Radio and Plasma Wave Teams' home page and the Operations Team home page.

In 1996 the Ulysses outreach office received a request to include the Ulysses spacecraft model in the Astronomical Science Museum of the Taipei Observatory, which has approximately 5,000 m^2 of exhibit area. With the assistance of the Ulysses ESA Project Manager and the coordination of the Ulysses Project Outreach office, a full-scale model of the Ulysses spacecraft was completed for viewing in July 1997 in this international museum. Many of the Ulysses articles, publications and brochures were translated into Chinese for this exhibit.

Publications:

The members of the Ulysses science team have published over 800 papers. These papers have been include in special issues of Science, Journal of Geophysical Research, Astronomy and Astrophysics and Scientific American. The science team members have also been instrumental in the development of the Ulysses mission bulletin, which is printed about every six months by the Ulysses Project Office at JPL. In this bulletin we print articles by the Principle Investigators about their specific instruments and findings, spacecraft status, location and updated information about the project team. The current external distribution for the Ulysses bulletin is over 2,000 which includes museums, elementary and high schools, science/astronomy clubs and institutions and universities throughout North America and Europe.

Collaborations:

In accordance with the Computers for Learning program, an Executive Order 12999, Educational Technology: Ensuring Opportunity for All Children in the Next Century, The JPL Ulysses Outreach Coordinator actively works with the NASA/Cheli Warehouse and the European Space Agency by assisting local schools in acquiring computers or computer upgrades for their classrooms.

Between January 5 and April 29, 1998 a unique scientific collaboration between the Ulysses mission and NASA's Advanced Composition Explorer (ACE) mission began when the two spacecraft and the Sun were radially aligned. During this collaboration ACE was within 1 astronomical unit (AU) of the Sun while Ulysses was 5.4 AU away from the Sun. This collaboration allowed scientists to study changes in solar phenomena as they propagated from near the Sun out to the distance of Ulysses. This collaboration was possible because there are three Ulysses flight spares on-board ACE: Solar Wind Electron, Proton, and Alpha Monitor; the Electron, Proton, and Alpha Monitor; and the Solar Wind Ion Composition Spectrometer. This type of scientific collaboration extends the ability of Ulysses data.

Ulysses data are available for collaborative studies through four sources. Data related to the Jupiter Flyby are archived at NASA's Planetary Data Center. Other data are archived at, NASA's National Space Science Data Center and ESA's Ulysses Data Center. Additionally, scientists wishing specific investigator data are typically archived less than one year after reception by the science teams.

Ulysses on the World Wide Web:

The Ulysses presence in hyperspace currently comprises 11 web sites. All can be accessed via the JPL Ulysses home page at http://ulysses.jpl.nasa.gov by selecting "Contacting Ulysses Scientists, Project, Science Team Home Pages". In addition each home page provides links to the others.

Future Activities:

In July 2000 the first Ulysses book, titled The Heliosphere at Solar Minimum, The Ulysses Prospective, is scheduled for publication. This approximately 500-page book will focus on major scientific findings from Ulysses during Solar Minimum. The editors are the ESA Project Scientist, Dr. Richard Marsden; the NASA Project Scientist, Dr. Edward Smith; and Dr. Andre Balogh, Principal Investigator for Magnetic Fields Team.

There are plans to produce a Ulysses Educational CD. The CD will be an interactive tool for students to learn more about the Dynamics of the Sun, the Ulysses project and it's contributions to understanding solar phenomena.

The goal is to provide enough information for teachers to develop classroom activities and for students, through self-instruction, to learn more about the Sun-Earth Connection.

The Project will host a one-hour interview with one science student (in California) every six months. This program is designed to share with a class through one student important facts about space science, ground systems and spacecraft operations, or project management (the student's choice). Applications must be submitted with recommendations from the science teacher before the selection process is made. Each interviewer will return to the classroom with a professional presentation for his or her peers.

The Ulysses spacecraft crossed the ecliptic on May 9, 1998, completing its first orbit of the Sun during minimum solar activity. Ulysses will start its second south polar pass on September 8, 2000, at which time the Sun's activity will be near solar maximum. Upon completion of the solar maximum orbit, Ulysses will have contributed data about the three-dimensional heliosphere during a complete solar cycle.

Conclusion:

During the course of its mission, particularly over the past three years, the Ulysses Project has increased public awareness about the Sun's activity and how it affects Earth's environment. This enlightenment has been made possible through scientific research, various public outreach programs and collaborations with other projects. The project's goal is to continue to share the mission's scientific findings to help the public and the scientific and educational communities enhance knowledge of the Sun-Earth Connection. Requests for classroom presentations, lectures and exhibits can be made by calling the Jet Propulsion Laboratory's Speakers Bureau at (818) 354-2413.

Acknowledgement:

The research described in this paper was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.